EXHIBIT 3
DATE 4/13/2015
SBJ 18

An overview of the potential benefits of Lidar data and analysis for the State of Montana

Helping prepare the State to gain maximum benefit from Lidar data is a complex problem that Senate Bill SJ18 seeks to address.

Lidar (also written LIDAR, LiDAR or LADAR), LIght Detection And Ranging, is a remote sensing technology that measures distance very accurately by illuminating a target with a laser and analyzing the reflected light.

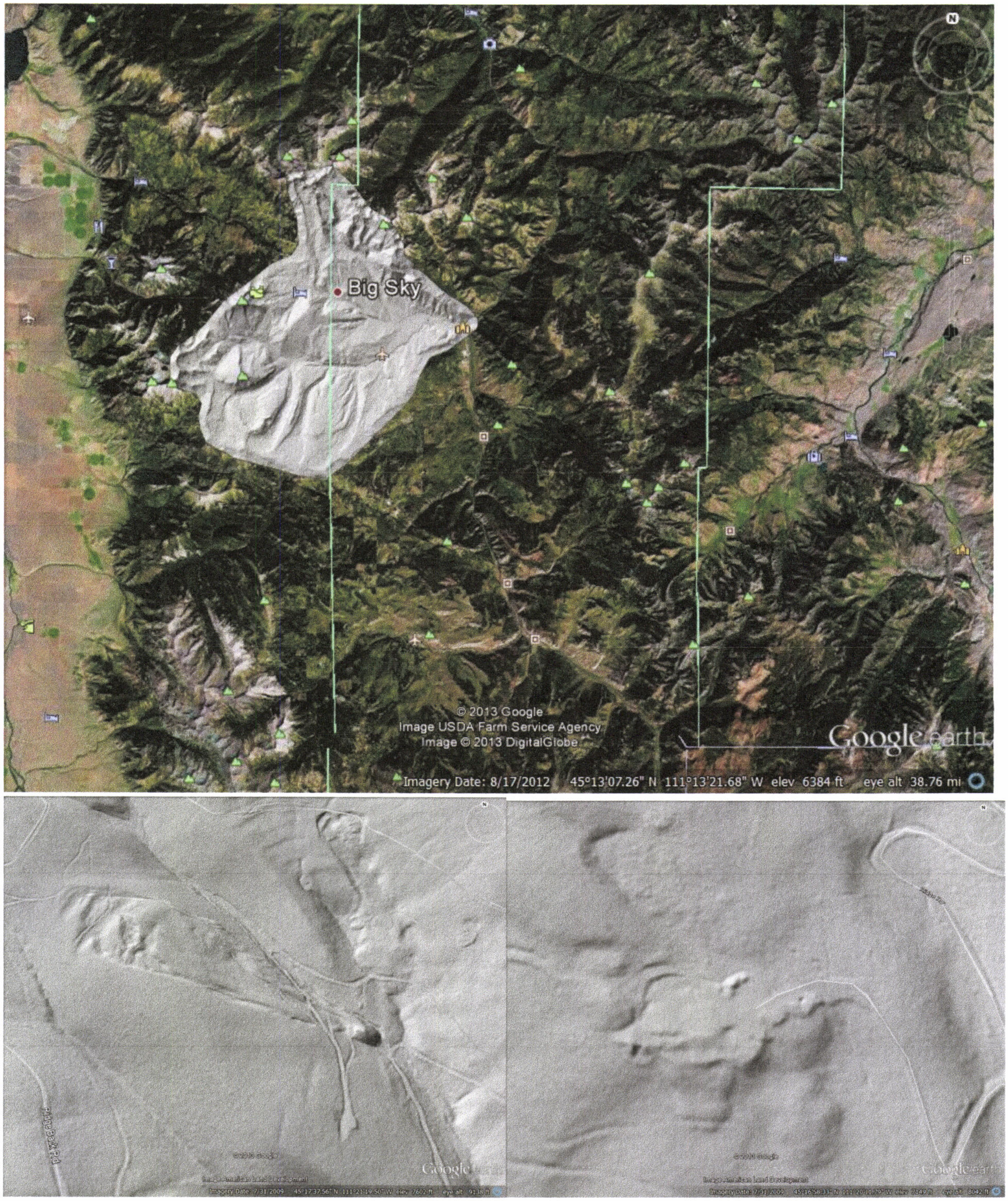
Lidar is most commonly used as a technology to make high-resolution maps, with applications in geology, geomorphology, seismology, forestry, hydrology remote sensing, atmospheric physics, airborne laser swath mapping (ALSM), laser altimetry, geomatics, archaeology, geography and contour mapping.

Lidar data alone provides highly accurate and precise measurement of the earth's surface both vertically (elevation) and horizontally (latitude and longitude). This data can be combined with other types of data such as imagery and reflected light to accurately map vegetation.

Lidar data has great value for the State of Montana. Although there are federal programs in place to obtain Lidar data throughout the U.S., these programs are directed at federally-managed lands; a state program to acquire lidar data for state lands would more directly benefit the people of Montana. In addition, a state program to utilize Lidar data provided by federal programs would greatly improve the management of valuable state assets like wildlife, wind, and solar energy, that are supported on federal lands.

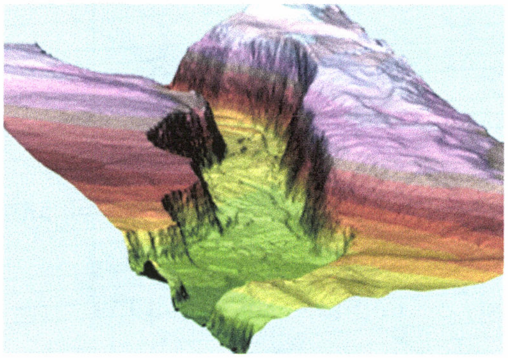
Lidar data is becoming increasingly available for Montana, but it will not necessarily cover areas that are most important from the point of view of state interests. It is an incredibly valuable tool for resource management, but using it effectively will require the state to develop the capacity to use it. Lidar (also written LIDAR, LiDAR or LADAR), LIght Detection And Ranging, is a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light.

Here are some examples of Lidar applications.



- Big Sky Lidar revealing landslides
under home sites, hidden by vegetation.

Energy Site Location: Calculating the Value of LiDAR Use in Alberta, Canada



Site selection within the energy sector in Alberta, Canada depends upon many factors. Traditionally surveyors are involved in the process but with the introduction of new 3D technologies, the role of the surveyor is no longer required for the site selection stage. LiDAR has proven beneficial for this kind of work and several advantages can be attributed to the technology for reasons involving timeliness, cost and improved efficiency.

The Alberta oil and gas exploration and surveying industry has undergone many changes over the past 10 years involving those areas where remotely sensed applications are being developed. Emphasis on safety and the environment have become paramount at a time when budgets are constrained and under pressure from many directions.

Fig. 1 - Identical Locations: Aerial Image (left) Bare Earth (right) Personal injury and risk management have remained primary objectives for most organizations, and solutions that include environmental friendliness and improved cost reductions in planning for projects are highly desired.

Technologies such as the Theodolite, Total Station, GPS, and RTK for GNSS instruments have brought greater efficiency and better productivity, aerial LiDAR is another tool in the survey industry that has altered the landscape when it comes to speed, cost, and accuracy. One major determining factor for the placement of a well site is the location of standing water or water courses. If a well site is within 100m of a terrain feature that can contain water, either temporarily or permanently, it has the potential of being rejected by SRD.

Because of LiDAR data's accuracy, most of these terrain features can be identified readily and selected prior to selection, therefore avoided during scouting in the office.

Comparative Cost-Value

One of Visual Modeling Analysis' (VMA) clients conducted a case study comparing the cost and time between a conventional survey and a LiDAR survey to create a compressor site, pad site, and 18.5 km of pipeline. They found that they saved $119,200 and received approval for their plans 18 days sooner just by including the use of LiDAR data in their pre-construction workflow.

Case Study of Compressor Site, Plant Site, 18.5km of Gathering & Mainline

LiDAR Planning and Survey			Conventional Survey		Difference	
LiDAR Data	$15,200	$0.80/m				
Planning Session	$6,000	$0.30/m				
Ground Truth & PLA Plan Prep.	$38,290	$2.10/m				
Total for Pipeline	$59,490	$3.20/m	$166,500	$9.00/m	$107,010	$5.80/m
Compressor Site	$1,600		$5,000		$3,400	
Plant Site	$1,300		$10,000		$8,700	
Grand Total	$62,300		$181,500		$119,200	
Timing						
Data Acquisition	Spec. Data Available					
Prep. & Planning Session	7 Days (Planning Session 5 Hours)		Field Survey 30 Days			
Field Truthing	5 Days				18 Days	

Surveying snowpack from the air

BY KATIE VANE IN NEWS 9 MAY, 2014

The Airborne Snow Observatory (ASO) is a project that is currently wrapping up its second season gathering snowpack data from the Tuolumne River Basin and Colorado's Uncompahgre River Basin. The ASO is a repurposed de Havilland Twin Otter plane, equipped with LiDAR (a remote sensing method that uses light in the form of a pulsed laser to generate three-dimensional information on surface characteristics), spectrometer, GPS, and an inertial measurement unit that tracks the pitch and yaw of the aircraft.

Together, the LiDAR and spectrometer, which measure both topography and reflected sunlight, create a three-dimensional map of the snowpack.

Incredibly, LiDAR data gathered from 20,000 feet in the air can measure snowpack topography to within 10 centimeters, Painter said.

The purpose of this data is to represent snowpack, particularly its water equivalent, "in a more meaningful way."

Until now, snowpack data was typically measured using snow courses or snow pillows. Both snow courses and pillows offer limited information, as neither one covers a large amount of terrain. The greater purpose of them is as an indicator of percentage [of average]," but water isn't allocated in percentages; it's allocated in acre-feet. Remote sensing is key to understanding the whole of the mountain snowpack.

Considering about 75 percent of the freshwater supply for the Western U.S. comes from snowmelt, understanding mountain snowpack and calculating the snow water equivalent with greater precision is crucial for more refined water management.

The more detailed snowpack data available through the ASO is already being put to use at Yosemite's Hetch Hetchy Reservoir. Last year, Hetch Hetchy relied on ASO data after their snow pillows melted out, leaving them with no direct snowpack information to inform their operations. With ASO, they had complete basin knowledge. This allowed Hetch Hetchy to more carefully budget water use in energy generation, among other things.

Not only the Los Angeles Department of Water and Power, but also Southern California Edison, Pacific Gas & Electric, Metropolitan Water District, Mammoth Community Water District, the National Weather Service, and many other agencies and organizations have expressed interest in the ASO data.

This year, the ASO found basin wide snow water equivalents of 73-78 percent of last year. In terms of volumes, that is 30,000-50,000 acre-feet less. Given California's three-year drought, demand has reached up hard against supply ... California needs to have that data now.

Archaeologist Discovers Mysterious Ancient Maya Citadel

Thu, Mar 26, 2015

For three decades, archaeologist Anabel Ford has been exploring and studying the ancient Maya site of El Pilar, but until now she has never encountered anything like the 'Citadel'.

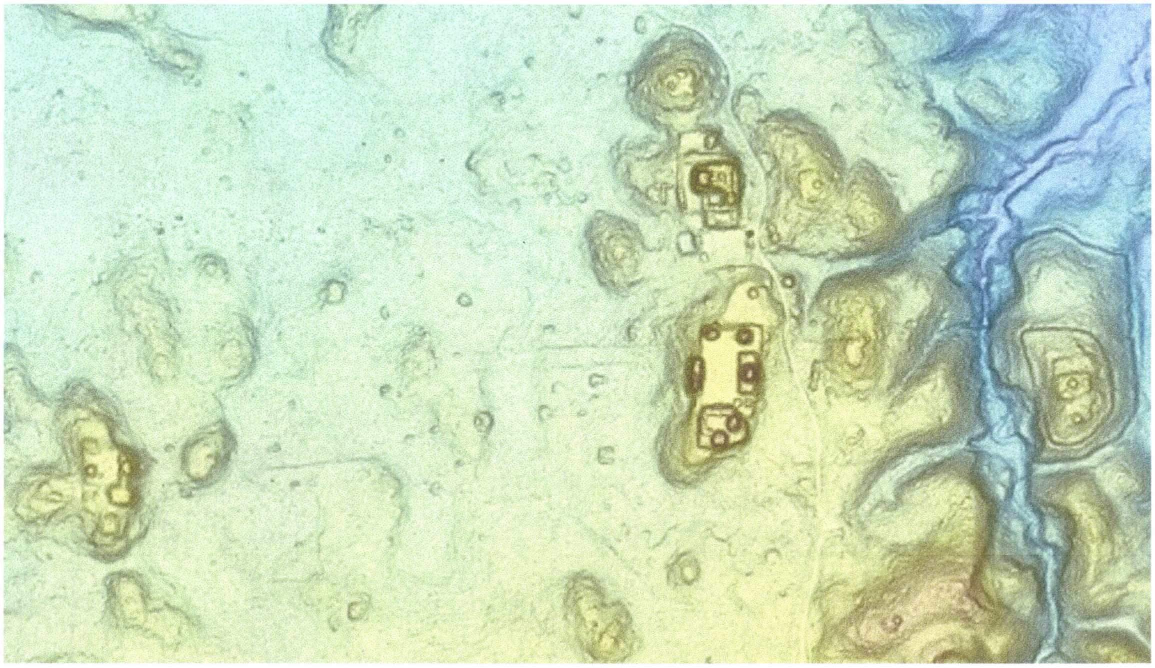
"We discovered a completely new component of the greater site that does not meet with any traditional expectations," said Ford. "It shares nothing in common with Classic Maya centers: no clear open plaza, no cardinal structure orientation, and curiously no evident relationship to the major Classic site of El Pilar, little more than 600 meters away."

What Ford was describing was an unseen building, or associated complex of buildings, that was recently only detected by remote sensing technology—more specifically, a laser application known as LiDAR, or Light Detection and Ranging—in this instance an airborne remote sensing technique utilizing a helicopter employing laser technology to penetrate the thick vegetation and forest canopy that overlies and enshrouds objects and structures. It is a way of 'seeing through' the forest to reveal things otherwise invisible to the naked eye.

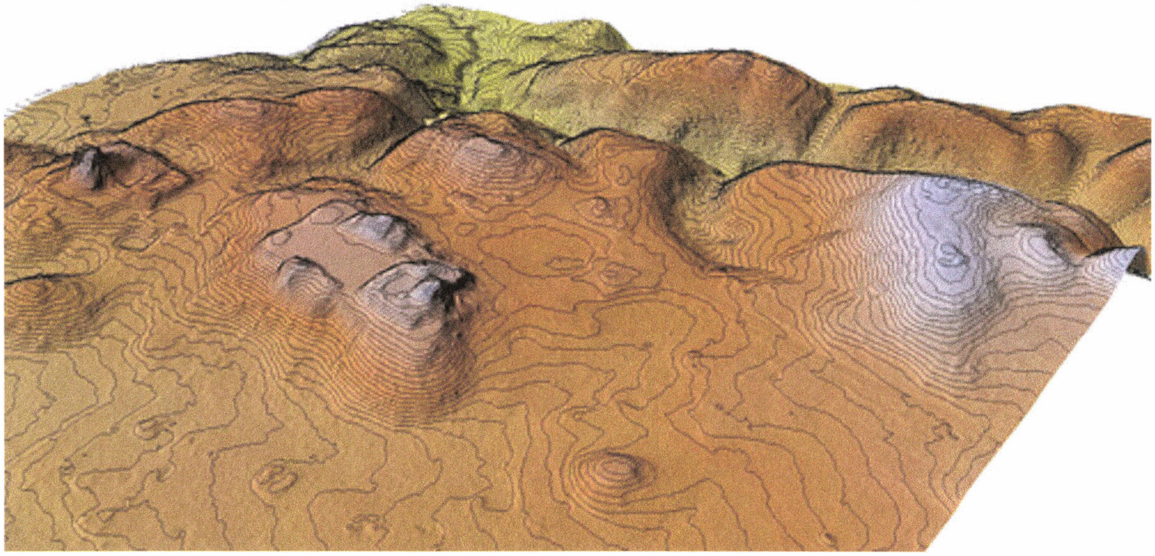
El Pilar lies below a thick jungle canopy. Courtesy BRASS/El Pilar

Above and below: Most of the El Pilar structures remain enshrouded in foliage, a natural strategy for conserving its remains. Courtesy BRASS/El Pilar Program

LiDAR image showing the core area of El Pilar. Courtesy BRASS/El Pilar



LiDAR image showing the core area of El Pilar. Courtesy BRASS/El Pilar



A new topographic map of the central El Pilar area as a result of the LiDAR survey. Courtesy BRASS/El Pilar

While traditional survey techniques have provided results in spite of the constraints of the dense forest, new and cutting edge technology, called LiDAR, may be a game-changer for archaeology in tropical areas. LiDAR (Light Detection And Ranging) is a laser-based remote sensing method that uses light in the form of a pulsed laser to measure ranges, or variable distances, to the Earth. It is capable of penetrating overlying vegetation and forest canopies, imaging at very high spatial resolutions with extraordinary accuracy. These light pulses, combined with other data recorded by airborne systems, produce precise points in a three-dimensional space to create a "point cloud" image for mapping.

Prior to LiDAR, many of the secrets of ancient Maya settlements remained hidden from view. Now, with LiDAR, large and small structures previously undetected can be made initially visible without traditional surveying, clearing and excavation. Successful identification of built structures from LiDAR, however, depends on the use of robust interpretive algorithms to extract terrain features from the data "point cloud". In other words, LiDAR results must be decoded to interpret cultural elements, and this is a work in progress. Inspection of the visualization results provides the "targets" for validation. These can be obvious residential compounds, suspected monuments, and more subtle features of small structures, depressions, and quarries. Validation in the field is critical to build the strategies for detecting the cultural features, and we need to look at all types of features, both those we think are positive ancient characteristics, as well as ambiguous or negative elements.

Bare earth DEM, Bitterroot River Valley, MT

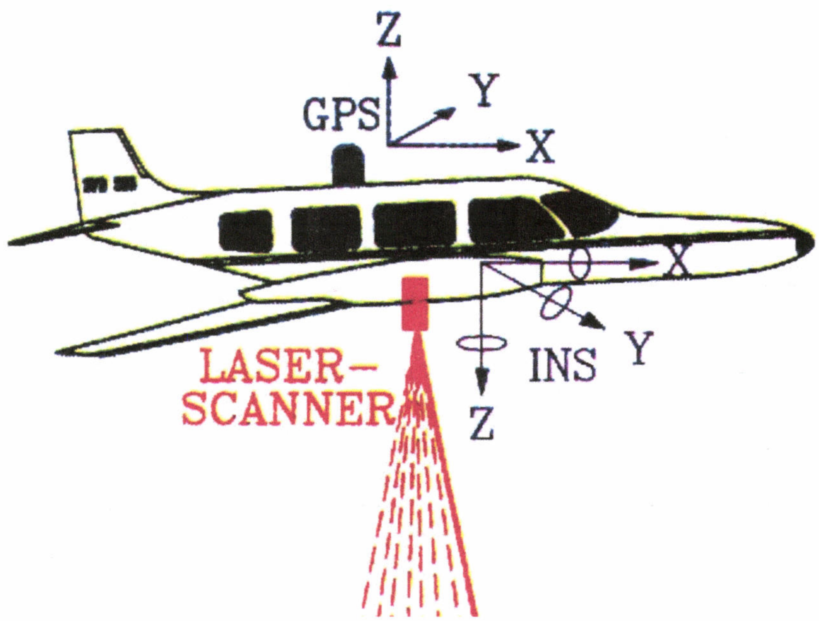
LiDAR Point cloud colored by ½ natural color imagery looking West/Southwest at the town of Polson, MT.; 3rd Avenue is running through the middle of the image

LiDAR Specifications Summary	
Multi-Swath Pulse Density	≥ 8 pulses/m^2
Scan Angle	≤30° (+/-15° from Nadir)
Returns Collected Per Laser Pulse	Up to 4
Intensity Range	1-255
Swath Overlap	50% side-lap (100% overlap)
GPS PDOP During Acquisition	≤3.0
GPS Satellite Constellation	≥6
Maximum GPS Baseline	13 nautical miles
$Accuracy_z$ (1.96 σ), *slope* <*20°*	≤ 30 cm
Vertical Accuracy (σ), *slope* <*20°*	≤ 15 cm
Horizontal Accuracy (σ)	≤ 30 cm

Lidar specifications 2013

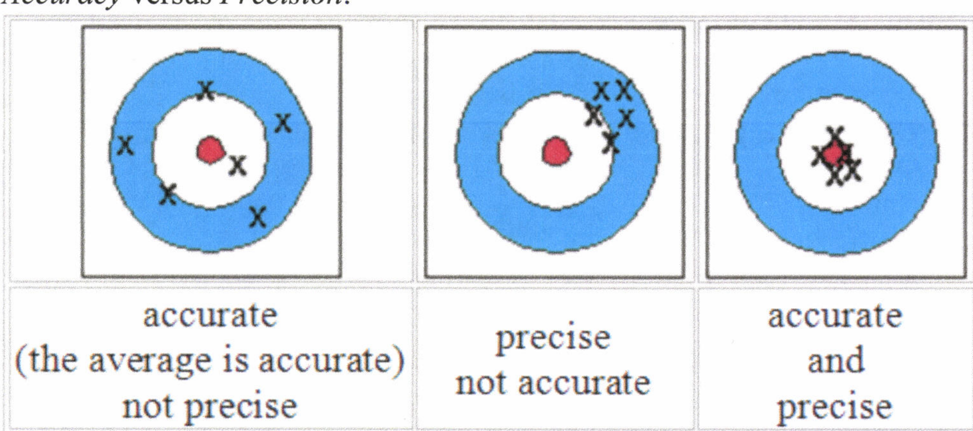
LiDAR (Light Detection And Ranging) is a remote sensing technology that uses light pulses to measure distance and other characteristics (texture, hardness, etc.) of terrain and objects. LiDAR is an active remote sensing technique where the light pulse is sent from the system and the length of time for the return signal is recorded, allowing for the distance between the sensor and the object imaged to be calculated. LiDAR systems can be either mobile (such as airborne LiDAR) or stationary. Both the position and orientation of the LiDAR sensor must be known in order to accurately measure distance. GPS (Global Positioning System) receivers are used to accurately determine the position of the aircraft and the environmental surface sensed with LiDAR. One of the final results of airborne LiDAR is a very accurate and high-resolution Digital Elevation Model (DEM) of the environmental surfaces remotely sensed with LiDAR.

LASER–SCANNING



1: LiDAR schematic. Image Source: Spencer B. Gross Inc., Portland OR.

Accuracy and Precision
The *accuracy* of a set of measurements describes how close they are to the true or actual value of the measured quantity. The *precision* of a set of measurements is the degree to which the measurements agree with each other. Reproducibility, replicability, and repeatability are synonyms for measurement *precision*. Figure 2 is an excellent graphic from an online Math Skills Review at the Texas A&M Department of Chemistry Website that visually illustrates *Accuracy* versus *Precision*:



Accuracy refers to how closely a measured value agrees with the correct value.
Precision refers to how closely individual measurements agree with each other.

Accuracy is the degree to which information on a map or in a digital database matches true or accepted values. Accuracy is an issue pertaining to the quality of data and the number of errors contained in a dataset or map. In discussing a GIS database, it is possible to consider horizontal and vertical accuracy with respect to geographic position, as well as attribute, conceptual, and logical accuracy.

Previous studies of LiDAR accuracy (Hodgson and Bresnahan, 2004; Hodgson et al., 2005; Gardina, 2008) have shown that there are several factors that affect the accuracy of LiDAR-derived elevations: internal errors within the LiDAR system, processing errors within the LiDAR algorithms (determining which points in the All-Data cloud are Ground and which are not), interpolation errors between LiDAR points, error in placement of ground control points (ground-truth), LiDAR point variation, slope of the surface being measured, and vegetation (land cover). Fowler (2000, 2001) stressed that there are physical limits on the ability of airborne LiDAR pulses to capture data based upon aircraft flying height, LiDAR impulse wavelength, GPS limitations, etc. There is therefore a physical limit beyond which airborne LiDAR cannot resolve. Fowler determined that the best you could achieve with airborne LiDAR under optimal conditions was about ± 0.5 foot. Additional errors due to system processing error compounded by vegetative conditions, slope, land cover, etc. all would cause actual accuracy to be less than optimal.

Ecofys experience with LiDAR
Assessing wind power potential in the Netherlands

Based on this industry acceptance, and our own experience with LiDAR campaigns, Ecofys sees a number of ways that LiDAR can enhance a wind measurement campaign:

1. LiDAR stand-alone on-site. In simple terrain (flat, few obstacles), a LiDAR can entirely replace a met mast for the wind resource assessment. This is typically recommended if the erection of a met mast is impossible or too time-consuming.
2. LiDAR next to a relatively short on-site met mast. This can be a cost-effective solution to quantify the wind shear and extrapolate wind speeds to hub height.
3. LiDAR moved around the site, complementing an on-site met mast. This can help to reduce the uncertainty in flow modelling. Several shorter campaigns spread throughout the year (called seasonal sampling) helps to reduce seasonal effects.

Example cost-benefit analysis for a representative Dutch inland site, comparing different measurement strategies

Cost-benefit analysis	Reference: Climate-based	Met mast only	1. LiDAR stand-alone	2. LiDAR next to mast	3. LiDAR moved around site
Approximate measurement costs [k€]	5	35	95	65	120
Uncertainty in energy yield [%]	17.0%	14.0%	12.0%	12.0%	10.8%
P_{90} / P_{50} ratio	78%	82%	85%	85%	86%
Leverage [%]	80%	82%	83%	83%	84%
Equity investment [k€]	5,400	4,800	4,400	4,400	4,200
Return on Equity [%]	9.7%	11.8%	13.4%	13.4%	14.5%
Increase in Net Present Value [k€] compared to reference case	-	700	1,100	1,100	1,300

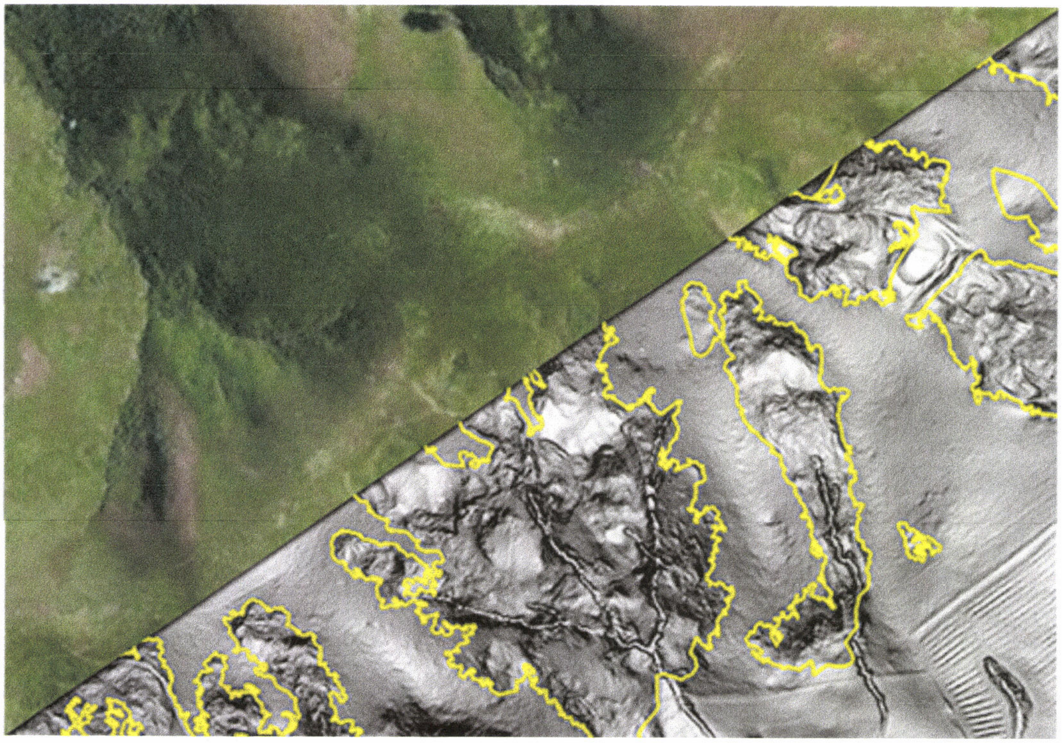
Conclusions

A wind measurement campaign aims to reduce project uncertainty, in order to improve bankability in terms of better financing terms and reduced project risks. LiDAR is now a mature technology and there is industry acceptance of LiDAR measurements in bankable wind resource assessment, provided the campaign is well designed. Our experience with the accuracy and flexibility of LiDAR deployments leads Ecofys to recommend LiDAR for specific purposes.

The optimal wind measurement strategy should be assessed on a site-by-site basis. The campaign should aim to reduce the key uncertainties, particularly in vertical and horizontal extrapolation. The costs of additional measurements can be compared to the benefits in terms of reduced equity investment and increased return on investments.

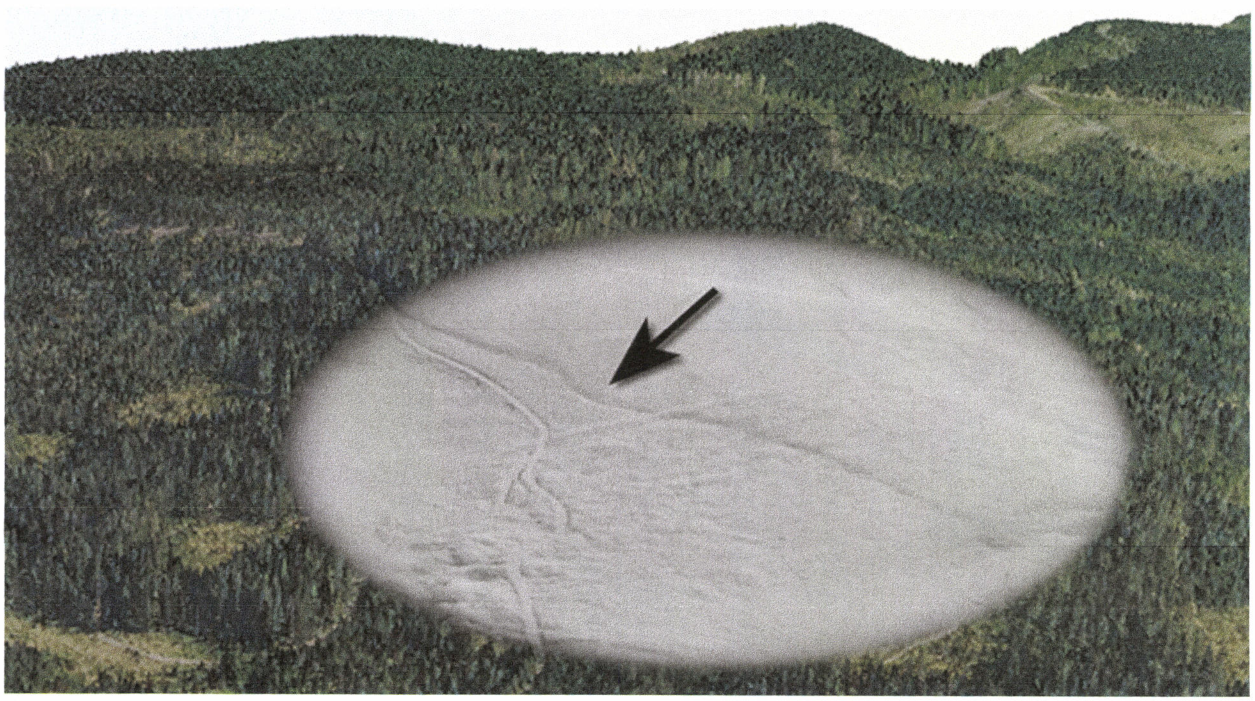
Landslide Detection

Identify areas of failed terrain such as slides, flows, and creep caused by environmental and human factors to better understand areas of concern. Quantum Spatial generates maps displaying landslides and their proximity to other features such as buildings, roads, tax lots, forest stands and urban infrastructure. LiDAR technology can detect historical terrain failure beneath tree and vegetation growth, which provides valuable intel on the location of landslides that are nearly impossible to identify using ground-truthing or aerial photography methods.



Fault Lineaments

Detect and monitor fault lines and lineaments features. Geologists have used our data to discover previously undetected faults, because of the high-resolution capabilities of LiDAR.

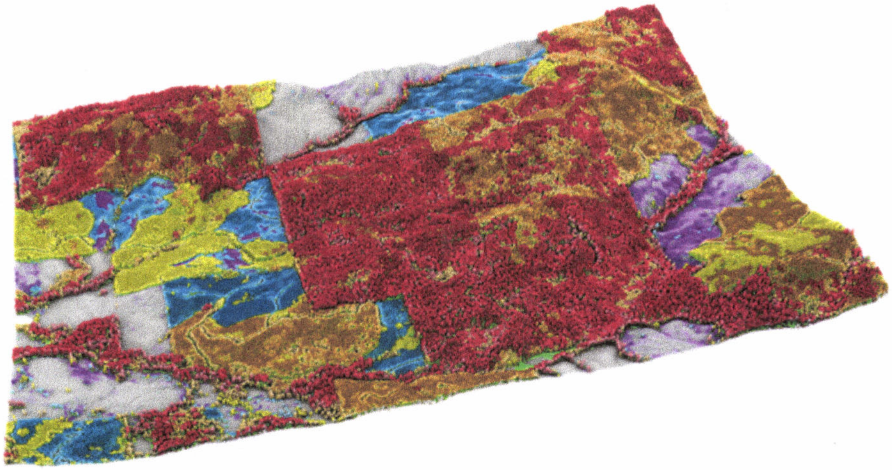


Individual Tree Delineation & Attribution

Calculate and catalog valuable forest metrics such as tree height, canopy cover, stem density, and crown area for individual trees in both forest and urban settings. Quantum Spatial has developed cutting-edge methodology that generates forest metrics directly from LiDAR points, which produces an accurate, detailed tree databases for entire study areas.

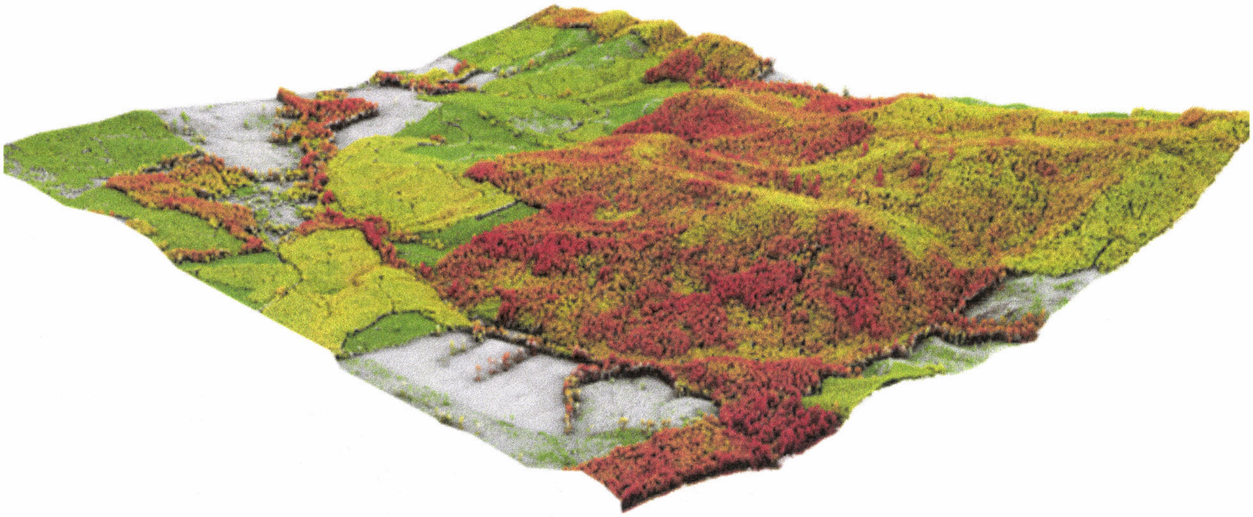
Forest Stratification

Model forest structure and use the results to make management decisions. When aggregated, individual tree metrics produce nuanced analysis of forest characterization. Incorporating Quantum Spatial's forest models aids timber management practices, supports habitat conservation efforts, and improves efficiency of ground surveys and research plot placement.



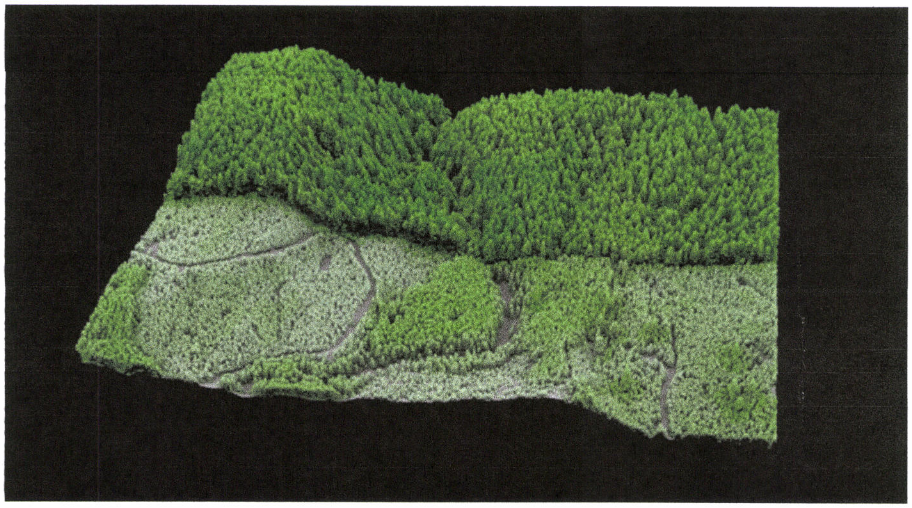
Wildfire Modeling

Forest metrics from LiDAR provide valuable information in the application of land use and management practices, fire suppression planning and fuel loading calculations. High resolution LiDAR also provides detailed terrain models for the determination of slope and aspect, as well as the identification of access roads delineation.



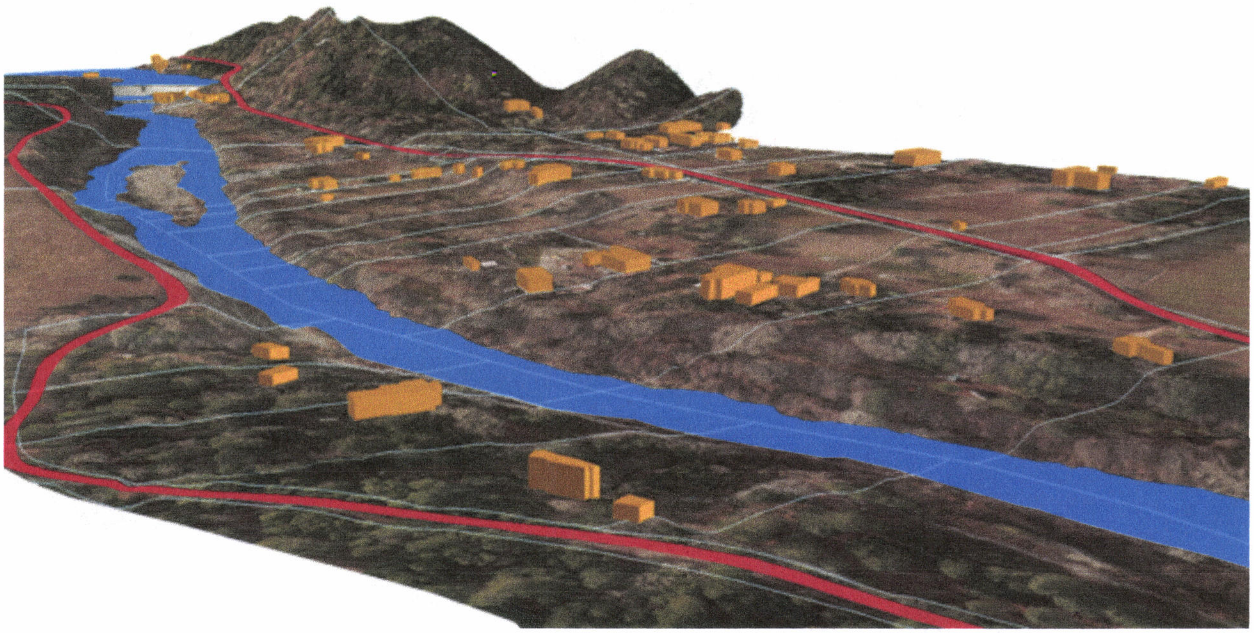
Carbon & Biomass Estimation

Quantify complex bio-relationships using our LiDAR data and analytics. In tandem with onsite measurements, we create linear regression models to calculate carbon, biomass, and related forest inventory parameters.



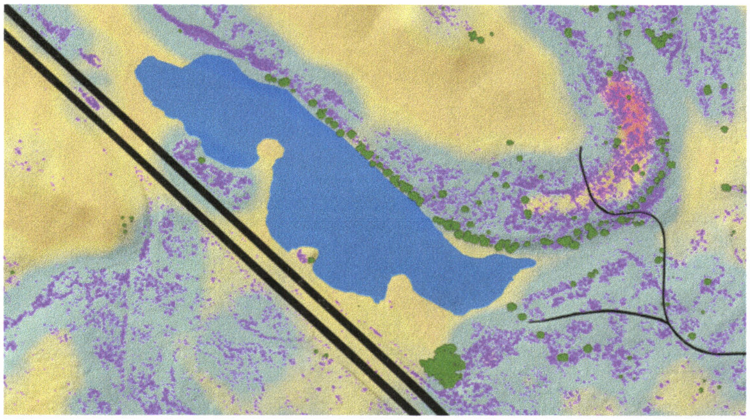
River and Watershed Management

Partner with the most technically-advanced provider of geospatial services for managing and analyzing rivers, streams, and watersheds. For more than a decade, we've been at the forefront of using geospatial techniques for water quality studies, erosion modeling, habitat monitoring, flood risk management, navigation, and hydroelectric design.



Wildlife and Habitat Management

Advance wildlife conservation efforts with high-resolution habitat maps and predictive habitat models. Our geospatial analyses have informed leading initiatives to sustain the wildlife populations and their habitat in coastal, riverine, rangeland, and forest settings.

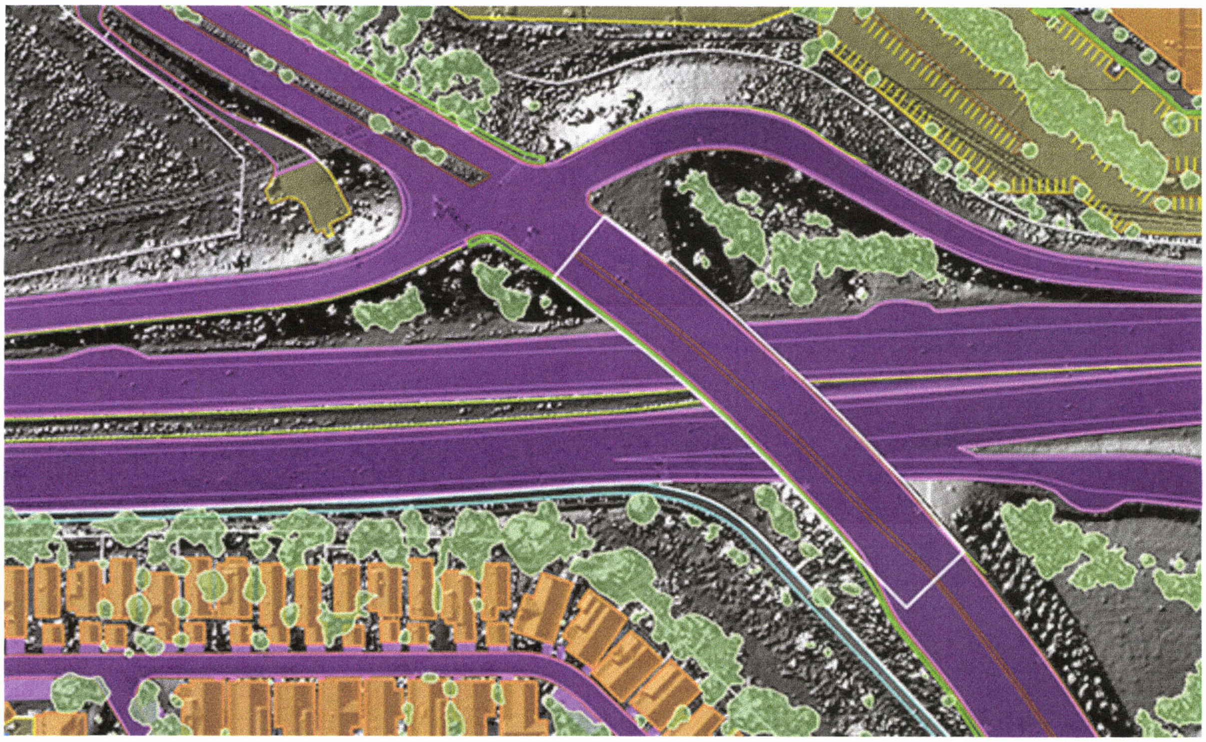


Transportation

Documentation

During construction – Track construction progress with a variety of services such as periodic HD video, orthophotography or LiDAR. Conducted on a regular schedule, this monitors project status, analyzes problem areas and documents the completion of milestones for stakeholders and the public.

After construction – Create maps and 3D models of the as-built environment for reference files, GIS databases, or to help launch future engineering work. Imagery can be used for orthophotography and planimetric mapping while LiDAR can be used for a variety of applications such as mapping final surface elevations and gradients, and extracting cross-section data sets. Mobile mapping systems can drive down the completed right-of-way and capture as-builts for the record.



State of Utah relies on LiDAR for geological research

General | 10.21.2014

Quantum Spatial collected and analyzed LiDAR data for Utah's Automated Geographic Reference Center. Government officials and researchers are using the LiDAR datasets in applications ranging from urban planning, forestry and geology.

SALT LAKE CITY — Geologist Adam McKean said experts knew there were some faults in the earth west of the Salt Lake International Airport.

"I would easily walk across this area without knowing there was a fault," McKean said.

But with traditional geology tools, previous geologists couldn't map them correctly. "You don't see a ledge or a cliff or a crack like you would normally expect on a geologic fault," McKean said.

Now, geologists know there are fault lines in the Salt Lake City area. “If your building was across this and it faulted, it would be bad. Your structure would collapse," McKean said.

A thin cover of vegetation is the reason the fault isn't apparent even to an expert's eye — or to many instruments. But an imaging technique called LIDAR almost literally strips the greenery away: “The LIDAR is really fantastic,” McKean said.

LIDAR is a lot like radar, except with lasers instead of radio waves.

A LIDAR unit mounted on an airplane shoots out millions of laser pulses, blanketing the landscape with tiny light beams. The LIDAR catches the light that bounces back. Just enough of the laser beams shoot through the vegetation and reflect back. That allows LIDAR computer processors to paint images of a landscape denuded of trees, shrubs, grass and even some lighter buildings.

If there's a grove of trees, we can see right through that grove of trees and see the ground underneath.

–Gregg Beukelman, the Utah Geological Survey

LIDAR imagery removes the vegetation to reveal drainage patterns. Experts can map drainage channels and discover other clues for potential runoff and flooding problems.

"It lets us see things that are so small, in so much detail, that otherwise we wouldn't know about," McKean said.

In City Creek Canyon the LIDAR technology has been extremely valuable in helping geologists map old landslides, some of which they never knew were there.

“So that's actually got a name (pointing to a hillside in City Creek Canyon) — The City Creek Landslide,” Gregg Beukelman from the Utah Geological Survey said.

Geologists knew about this trouble spot because it slides just about every time a wet year comes along.

But many old landslides remained hidden by vegetation, on slopes that have homes on top of them, and once again LIDAR has technology paid off.

“If there's a grove of trees, we can see right through that grove of trees and see the ground underneath,” Beukelman said.

This technology has allowed geologists to map several hidden landslides.

“There's clear evidence of lots of landslides here, yes, and that's why the LIDAR technology has become hugely valuable,” Beukelman said.

When one landslide happens there could easily be future landslides for experts, planners and yes, even homeowners.

In 2014 Lincoln Laboratory announced a new imaging chip with more than 16,384 pixels, each able to image a single photon, enabling them to capture a wide area in a single image. An earlier generation of the technology with one-quarter as many pixels was dispatched by the U.S. military after the January 2010 Haiti earthquake; a single pass by a business jet at 3,000 meters (10,000 ft.) over Port-au-Prince was able to capture instantaneous snapshots of 600-meter squares of the city at 30 centimetres (12 in) displaying the precise height of rubble strewn in city streets.

The new system is another 10x faster. The chip uses indium gallium arsenide (IGA), which operates in the infrared spectrum at a relatively long wavelength that allows for higher power and longer ranges.